Induced dimensional set and concept learning*

DON FERNANDEZ
University of Victoria, Victoria, British Columbia, Canada

First-grade children were presented with one of two scaling procedures: standard dimensional preference scaling (preference scaling) or scaling designed to induce a color set (color-set scaling). Following scaling, a concept-learning problem with either form or color relevant to solution was presented. The finding that form-preferring Ss, as determined by preference scaling, perform well when form is relevant and poorly when color is relevant was replicated. Ss given color-set scaling, however, performed significantly better when color was relevant than when form was relevant. The results are discussed in terms of response set.

Children have been shown to exhibit preferences for particular dimensions of experimental stimuli in free-choice scaling tasks (Brian & Goodenough, 1929; Colby & Robertson, 1942; Kagan & Lemkin, 1961; Odom & Guzman, 1972; Suchman & Trabasso, 1966a). A child who matches multidimensional scaling stimuli on the basis of form, for example, is said to exhibit a form preference. When presented with experimental stimuli, that child is assumed to attend first to the form dimension and to base overt responses on that dimension.

Dimensional preference has been related to development (e.g., Odom & Guzman, 1972), concept learning (e.g., Suchman & Trabasso, 1966b; Wolff, 1966), recall and incidental learning (Odom, 1972), and, recently, extradimensional shift performance (May, Fernandez, & Wilson, 1972). A developmental trend from color to form preference has been generally demonstrated in the literature. Learning tasks are facilitated when the S's preferred dimensions are made relevant to the solution or correct choice.

In concept learning, the speed and ease of problem solution is related to the concurrence of preferred and relevant dimensions. When the preferred dimension is relevant to solution, the solution is attained rapidly and with few errors. When the nonpreferred dimension is relevant, more trials to criterion and more errors result.

Research into the effects of dimensional preference on concept learning involves a two-stage paradigm: First, Ss are presented with a scaling task to evaluate dimensional preferences; second, Ss are given a concept-learning problem with preferred or nonpreferred dimension relevant to solution.

*This research was partially supported by NRC Grant PA0342 to Dr. Richard B. May, University of Victoria. The paper is sponsored by Tom Trabasso, who takes full editorial responsibility for its contents. Author's address: Department of Psychology, University of Victoria, Victoria, B.C., Canada.

Recently, some questions have arisen concerning the effects of preference scaling procedures on subsequent performance. Scaling procedures may act to produce or affirm a response set in Ss. Milter & Harris (1969) found a "setting" effect due to prior preference scaling experience. Kindergarten children, given a scaling task after concept learning, solved a number-relevant problem more readily than Ss scaled prior to concept learning. Milter and Harris concluded that dimensional preference scaling tended to set Ss to respond to form (the predominantly preferred dimension).

Tighe, Tighe, Waterhouse, & Vasta (1970) also demonstrated differential performance in concept learning due to preference scaling before or after the concept-learning problem. Ss scaled prior to the problem performed significantly better when their preferred dimension was relevant to solution. Ss scaled after the problem demonstrated no relationship between preference and rate of learning.

Preference scaling, then, may act to strengthen or reaffirm an existing response set in children.

Direct manipulation of dimensional preference was attempted by Corah (1966). A "performance set" procedure was employed in which scaling stimuli allowed for a match along only one dimension, either color or form, exclusively. Kindergarten children demonstrated significant increases in later color matching of standard scaling stimuli following initial scaling with color performance set stimuli. No increase in form matching was attained. Corah's study further suggests that what is called dimensional preference may well be response set.

The present study was designed to assess the influence of an induced dimensional set on concept learning. Stage 1 involved a standard preference scaling task, which is assumed to strengthen form response set, and Corah's (1966) procedure to induce a color set with first-grade children. Stage 2 involved presentation of a concept-learning problem, with color or form relevant to solution. Children over 5 or 6 years of age have been shown to be predominantly form preferrers (e.g., Brian & Goodenough, 1929; Odom & Guzman, 1972). When presented with a form-relevant concept-learning problem following preference scaling, these children typically make few errors and take few trials to criterion. When presented with a color-relevant problem, more errors and trials to criterion are usually made. It is predicted here that a similar relationship will result with an induced dimensional set. Children given color-set scaling prior to concept learning may attend more readily to the color dimension as a result. When presented with a color-relevant problem, these children should perform

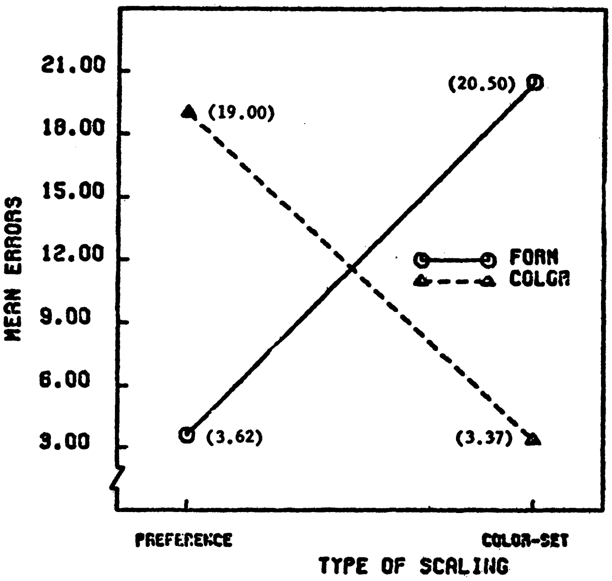

Fig. 1. Plot of the Type of Scaling by Dimension Relevant interaction with errors. The four means are given in parentheses.

well, i.e., make few errors and require few trials to criterion. When presented with a form-relevant problem, more errors and trials to criterion should result. It should be noted that, in three previous studies, over 100 first-grade children from the same school district have been scaled and found to be, with few exceptions, form dominant. Therefore, the assumption that the present Ss in the color-set condition are originally form dominant seems a tenable one. Any significant increase in attention to the color dimension should be related to the experimental manipulation.

METHOD

Subjects and Design

The Ss were 32 first-grade children from a public school in Victoria, British Columbia. There were an equal number of boys and girls. The mean age in months was 78.19, with a range of 72 to 92 months.

Ss were assigned randomly to preference or color-set scaling conditions, with the restriction that equal numbers of boys and girls were in both conditions. Half the Ss in each condition were assigned randomly a concept-learning problem with form relevant and half a problem with color relevant (again, counterbalanced for sex). The correct stimulus values of both dimensions were counterbalanced across conditions. The design was a 2 (type of scaling) by 2 (dimension relevant) by 2 (sex) randomized factorial.

Apparatus

All testing was conducted in one room of a mobile laboratory. Stimulus cards were presented in front of S on a 58-cm-sq table.

Stimuli used in Stages 1 and 2 were colored two-dimensional geometric figures on 20.4 x 15.2 cm white cardboard cards. Red and blue colored paper was used for the solid colored geometric figures, manufactured by the Schmidt Printing Inks Company of Montreal.

Preference Scaling Stimuli

The figures were arranged in triads. Each card had three figures, one at each corner of an imaginary triangle. Three dimensions were used (color, form, and size), with two values per dimension (red-blue, circle-triangle, and 2.8- vs 1.8-cm-diam circle/3.4- vs 2.2-cm equilateral triangle). On each card S could match a pair of figures on the basis of color, form, or size. Sixteen combinations of values and position were randomly chosen and used for all Ss.

Color-Set Scaling Stimuli

Color-set stimuli were identical to preference scaling stimuli, with the exception that three forms (circle, triangle, and square) were always present, and size was held constant on each card. The large square was 2.7 cm on a side and the small square was 1.7 cm on a side. A color match response was the only appropriate response, since all three forms on each card were different and were the same size.

Concept-Learning Stimuli

Each card in the concept-learning task had two figures, 6 cm apart, in the center of the card. The values of color, form, and size on these cards were the same as those used in preference scaling cards. For example, one card consisted of a large blue circle and a small red triangle as the pair of figures. All eight combinations of these cards were used.

Procedure

Each S was taken to the mobile laboratory and asked to "play a game with some cards." Ss sat in a chair opposite E, and stimulus cards were presented directly in front of them on the table.

For both preference and color-set scaling, S was told to point to which two of the three figures on each card he thought were "the same, most alike." All sixteen cards were presented one at a time and shuffled between Ss. The only feedback given was "thank you" and "now let's do these three." Only Ss who gave 12 or more form (in preference scaling) or color (in color-set scaling) responses continued in the experiment.

At the end of scaling, S was told that he could play a different game. The first concept-learning card was placed in front of S, and he was told that he was to guess which of the two figures on each card E was thinking of. The S was told that a certain kind of figure was always right and that if he was careful he could guess right every time. Feedback was given on every trial. The cards were shuffled at the end of each eight-trial block. Testing was continued to a criterion of eight consecutive correct responses or to 40 trials.

Following concept learning, all Ss were presented with the 16 preference scaling cards to determine posttest dimensional preferences.

RESULTS AND DISCUSSION

A total of 37 children were tested, 5 of whom were eliminated for failure to perform adequately on the scaling task. Two children did not make 12 or more form matches in preference scaling and three did not make 12 or more color matches in color-set scaling.

Errors and trials to criterion were correlated .97 and yielded identical results. Only the former are reported. As seen in Fig. 1, children in preference scaling tested with form relevant in concept learning and children in color-set scaling tested with color relevant performed well. Children in preference scaling/color-relevant and color-set scaling/form-relevant conditions made more errors. Variances were homogeneous ($F_{max} = 6.88$, $df = 2/7$, $p < .01$). The analysis of variance yielded no main effects and a significant Type of Scaling by Dimension Relevant interaction ($F = 78.97$, $df = 1/24$,

$p < .001$). The Type of Scaling by Dimension Relevant interaction resulted in η^2 of .73; thus, this effect accounted for 73% of the total variance.

In posttest scaling 100% of the Ss in preference scaling conditions made all form matches. Twelve of 16 Ss in color-set scaling conditions made all color matches, and 4 of 16 Ss made all form matches. This result suggests that the induced color set was sufficient to increase color matching in the majority of children, even when the form match was available. All four Ss in the color-set scaling condition who gave form matches had been given a color-relevant concept-learning problem and, thus, might be expected to exhibit a color set. Perhaps relative strengths of dimensional sets differ in Ss, with some Ss being more likely to discount immediate experience and revert to matching on the basis of their dominant dimension.

It appears that color-set scaling did induce a set to respond to the color dimension in a subsequent concept-learning problem. The finding that naturally form-preferring Ss (i.e., those who match scaling stimuli on the basis of form) perform well when form is relevant to solution in concept learning and poorly when color is relevant was replicated. Further, it was demonstrated that an experimentally induced dimensional set results in a similar preference-performance relationship. Ss given an induced color set performed well when color was relevant and poorly when form was relevant. It is assumed that those Ss attended more readily to the color dimension due to immediately preceding experience.

Experience can influence dimensional preference and subsequent performance, as demonstrated by Caron (1969) and Gaines (1970), who used younger children and longer training sessions than in the present experiment. The present results indicate that even a small amount of experience afforded by scaling may alter older Ss' selective attending in a subsequent concept-learning problem.

The concept of dimensional preference might best be approached as a form of response set. Such dimensional sets are subject to influence by a relatively short exposure to stimulus dimensions prior to concept learning.

REFERENCES

Brian, C. R., & Goodenough, F. L. Relative potency of color and form perception at various ages. Journal of Experimental Psychology, 1929, 12, 197-213.

Caron, A. J. Discrimination shifts in three-year-olds as a function of dimensional salience. Developmental Psychology, 1969, 1, 333-339.

Colby, M. G., & Robertson, J. B. Genetic studies in abstraction. Journal of Comparative Psychology, 1942, 33, 385-401.

Corah, N. L. The effect of instruction and performance set on color form perception in young children. Journal of Genetic Psychology, 1966, 108, 351-356.

Gaines, R. Children's selective attention to stimuli: Stage or set? Child Development, 1970, 41, 979-991.

Kagan, J., & Lemkin, J. Form, color, and size in children's conceptual behavior. Child Development, 1961, 32, 25-28.

May, R. B., Fernandez, D., & Wilson, A. Extradimensional shifts and dimensional preference. Unpublished manuscript, University of Victoria, 1972.

Milter, M. M., & Harris, L. Dimension preference and performance on a series of concept identification tasks in kindergarten, first-grade, and third-grade children. Journal of Experimental Child Psychology, 1969, 7, 374-384.

Odom, R. D. Effects of perceptual salience on the recall of relevant and incidental dimensional values: A developmental study. Journal of Experimental Psychology, 1972, 92, 285-291.

Odom, R. D., & Guzman, R. D. Development of hierarchies of dimensional salience. Developmental Psychology, 1972, 6, 271-287.

Suchman, R. G., & Trabasso, T. Color and form preference in young children. Journal of Experimental Child Psychology, 1966a, 3, 177-187.

Suchman, R. G., & Trabasso, T. Stimulus preference and cue function in young children's concept attainment. Journal of Experimental Child Psychology, 1966b, 3, 188-198.

Tighe, L. J., Tighe, T. J., Waterhouse, M. D., & Vasta, R. Dimensional preference and discrimination shift learning in children. Child Development, 1970, 41, 737-746.

Wolff, J. L. The role of dimensional preference in discrimination learning. Psychonomic Science, 1966, 5, 455-456.

(Received for publication January 15, 1973.)